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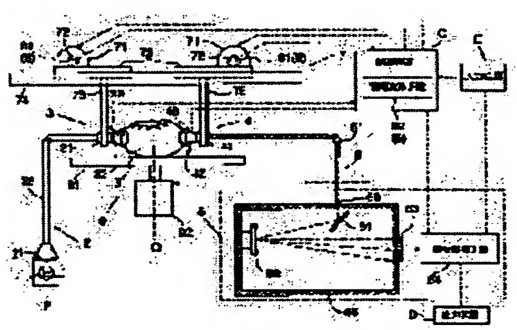
(54) SPECTRUM ANALYSER

(57)Abstract:
PURPOSE: To provide a spectrum analyser capable of simply obtaining a component contained in a sample even when the size or shape of the sample is different.
CONSTITUTION: The spectrum analyser is equipped with an irradiation part 3 irradiating a sample with the measuring luminous flux from a light source 1, a light detection part 4 detecting the light passing through the sample and a spectrum analyzing means 6 obtaining the spectrum of the transmitted light detected by the light detection part 4 to obtain the component contained in the sample on the basis of the obtained spectrum. Further, an interval altering means 7 altering the interval between the irradiation part 3 and the light detection part 4 and an interval measuring means 8 measuring the interval between the irradiation part 3 and the light detection part 4 are provided and the spectrum analyzing means 6 corrects the component calculated on the basis of the interval measured by the interval measuring means 8.



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CLAIMS

[Claim(s)]
[Claim 1] The exposure section (3) which irradiates the bundle of rays for measurement from the light source (1) at a sample, and the light sensing portion which receives the transmitted light which penetrated said sample (4), It is spectral-analysis equipment with which a spectral-analysis means (6) to ask for the component contained in said sample based on a spectrum was established. the spectrum of the transmitted light which the light sensing portion (4) received -- the spectrum which obtained the spectrum and was obtained -- A spacing modification means to change spacing of said exposure section (3) and said light sensing portion (4) (7), It is spectral-analysis equipment which an interval measurement means (8) to measure spacing of said exposure section (3) and said light sensing portion (4) is established, and is constituted so that said spectral-analysis means (6) may amend the component for which it asks based on spacing which said interval measurement means (8) measured.
[Claim 2] two or more different locations [in / based on rotation of said sample according / in said sample, the sample supporter (9) which supports said sample is constituted so that it may be rotatable, and / said spectral-analysis means (6) / to said sample supporter (9) / said sample] -- setting -- a spectrum -- two or more spectra which obtained a spectrum and were obtained -- the spectral-analysis equipment according to claim 1 constituted so that it may ask for the component contained in said sample based on a spectrum.
[Claim 3] Said light source (1) and said exposure section (3) are connected with the optical fiber for an exposure (22) which leads the pencil of light rays for measurement from said light source (1) to said exposure section (3). Said light sensing portion (4) and said spectral-analysis means (6) are spectral-analysis equipment according to claim 1 or 2 connected with the optical fiber for light-receiving (51) which leads the transmitted light which said light sensing portion (4) received to said spectral-analysis means (6).

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] the spectrum of the transmitted light which the exposure section to which this invention irradiates the bundle of rays for measurement from the light source at a sample, the light sensing portion which receives the transmitted light which penetrated said sample, and its light sensing portion received -- the spectrum which obtained the spectrum and was obtained -- it is related with the spectral-analysis equipment with which a spectral-analysis means to ask for the component contained in said sample based on a spectrum was established.
[0002]
[Description of the Prior Art] This spectral-analysis equipment detects the class of component contained in the sample for [, such as garden stuff,] analysis, or carries out the quantum of the amount of components, and asks for the component contained in a sample. In this spectral-analysis equipment, the exposure section and a light sensing portion had fixed and prepared those spacing in the predetermined value in the condition of having fixed, conventionally.
[0003]
[Problem(s) to be Solved by the Invention] However, when there is a thing of various magnitude in the sample for analysis and the forms of a sample differ, the configuration and magnitude of a sample differ from each other. Therefore, in the former, the sample needed to be fabricated by cutting etc. according to spacing of the exposure section and a light sensing portion, and it was very troublesome at it.
[0004] This invention is made in view of this actual condition, and the purpose is in offering the spectral-analysis equipment which can ask for the component simply contained in a sample, even if the magnitude and the configuration of a sample differ from each other.
[0005]
[Means for Solving the Problem] A spacing modification means by which the 1st description configuration of the spectral-analysis equipment by this invention changes spacing of said exposure section and said light sensing portion, and an interval measurement means to measure spacing of said exposure section and said light sensing portion are established, and said spectral-analysis means is in the point constituted so that the component for which it asks based on spacing which said interval measurement means measured may be amended.
[0006] two or more different locations [in / based on rotation of said sample according / the sample supporter with which the 2nd description configuration supports said sample is constituted so that it may be rotatable in said sample, and / said spectral-analysis means / to said sample supporter / said sample] -- setting -- a spectrum -- two or more spectra which obtained a spectrum and were obtained -- it is in the point constituted so that it may ask for the component contained in said sample based on a spectrum.

[0007] The 3rd description configuration is connected with the optical fiber for an exposure with which said light source and said exposure section lead the pencil of light rays for measurement from said light source to said exposure section, and said light sensing portion and said spectral-analysis means are in the point connected with the optical fiber for light-receiving which leads the transmitted light which said light sensing portion received to said spectral-analysis means.

[0008]

[Function] The operation by the 1st description configuration is as follows. According to the magnitude and the configuration of a sample, spacing of the exposure section and a light sensing portion is changed with a spacing modification means. Although the distance (the optical path length is called hereafter) in which the bundle of rays for measurement from the exposure section passes a sample differs and the absorbances of the bundle of rays for measurement irradiated by the sample differ since the magnitude of a sample differs, it turns out that the absorbance of the bundle of rays for measurement is proportional to the optical path length. Then, spacing (namely, optical path length) of the exposure section and a light sensing portion is measured with an interval measurement means, and a spectral-analysis means amends the component for which it asks based on the time between measurements.

[0009] The operation by the 2nd description configuration is as follows. the location where a sample rotates with a sample supporter and the plurality in a sample changes with spectral-analysis means based on the rotation -- setting -- a spectrum -- a spectrum -- obtaining -- the spectrum of these plurality -- it asks for the component contained in a sample based on a spectrum.

[0010] The operation by the 3rd description configuration is as follows. Although the light source and a spectral-analysis means are large-sized and weight is heavy, since, as for each optical fiber, it has flexibility when changing spacing of the exposure section and a light sensing portion, the light source and a spectral-analysis means are in the fixed condition, and can change spacing of the exposure section and a light sensing portion by making the exposure section and a light sensing portion approach mutually, or making it move so that it may be made to estrange. therefore, the exposure section and a light sensing portion small [a spacing modification means] and lightweight -- approach and alienation -- it can constitute so that it may be made to move. Moreover, since a sample can be arranged in the location distant from the light source, it can prevent the effect of the heat from the light source to a sample.

[0011]

[Effect of the Invention] According to the 1st description configuration, even if the magnitude and the configuration of a sample differed from each other, it could ask for the component simply contained in a sample.

[0012] two or more spectra which were obtained in each location where plurality differs according to the 2nd description configuration -- since it asked for the component contained in a sample based on a spectrum, it could ask for the component with a much more sufficient precision. It is effective when asking for the component of the sample from which a consistency differs with a location like a cabbage or a green pepper especially.

[0013] according to the 3rd description configuration -- the exposure section and a light sensing portion small [a spacing modification means] and lightweight -- approach and alienation -- since what is necessary is just to constitute so that it may be made to move, it can consider as an easy configuration and the cost for carrying out this invention can be reduced. Moreover, since the effect of the heat from the light source to a sample can be prevented, it is suitable when asking heat for the component of a weak sample like garden stuff especially.

[0014]

[Example] The example applied to the spectral-analysis equipment which analyzes hereafter the component contained in garden stuff in this invention is explained based on a drawing. The first optical system 2 by which spectral-analysis equipment fabricates the bundle of rays for measurement

from the light source 1 and its light source 1 as shown in drawing 1 , The exposure section 3 which irradiates the bundle of rays for measurement from the 1st optical system 2 at Sample S, and the light sensing portion 4 which receives the transmitted light which penetrated Sample S, the spectrum of the transmitted light led according to the second optical system 5 which draws the transmitted light which the light sensing portion 4 received, and the second optical system 5 -- the spectrum which obtained the spectrum and was obtained -- with a spectral-analysis means 6 to ask for the component contained in Sample S based on a spectrum A spacing modification means 7 to change spacing (namely, the optical path length L) of the exposure section 3 and a light sensing portion 4, an interval measurement means 8 to measure spacing of the exposure section 3 and a light sensing portion 4, and the sample supporter 9 that supports Sample S in the rotatable condition are constituted as main components.
[0015] The light source 1 consists of tungsten halogen lamps which emit infrared light. The lens 21 which fabricates the light source bundle for measurement from the light source 1 to a parallel pencil of rays, and the optical fiber 22 for an exposure which leads a parallel pencil of rays to the exposure section 3 constitute the first optical system 2. The optical fiber 51 for light-receiving which leads the transmitted light which the light sensing portion 4 received to the spectral-analysis means 6 constitutes the second optical system 5. That is, the light source 1 and the exposure section 3 are connected with the optical fiber 22 for an exposure which leads the pencil of light rays for measurement from the light source 1 to the exposure section 3, and the light sensing portion 4 and the spectral-analysis means 6 are connected with the optical fiber 51 for light-receiving which leads the transmitted light which the light sensing portion 4 received to the spectral-analysis means 6. As shown also in drawing 2 , a contact detection means 33 to detect the fiber attaching part 31 which inner-****** the optical fiber 22 for an exposure, the pad 32 made of rubber of the bowl configuration which sticks to Sample S and shades the light from the outside, and that the exposure section 3 contacted Sample S constitutes the exposure section 3. Similarly, the fiber attaching part 41 to which a light sensing portion 4 also inner-****** the optical fiber 51 for light-receiving, the pad 42 made of rubber of a bowl configuration which sticks to Sample S and shades the light from the outside, and a contact detection means 43 to detect that the light sensing portion 4 contacted Sample S constitute. The limit switch which outputs ON signal constitutes the contact detection means 33 and 43 by contacting Sample S.
[0016] The spectral-analysis means 6 is equipped with a signal-processing means 64 to process the output signal from the reflecting mirror 61 which reflects the transmitted light drawn with the optical fiber 51 for light-receiving, the concave grating 62 which carries out the part light reflex of the transmitted light reflected by the reflecting mirror 61, the array mold photo detector 63 which detects the bundle-of-rays reinforcement for every wavelength in which the part light reflex was carried out by the concave grating 62, and the array mold photo detector 63. The array mold photo detector 63 changes and outputs the transmitted light by which the part light reflex was carried out by the concave grating 62 to the signal for every wavelength while receiving light for every wavelength to coincidence. Moreover, the array mold photo detector 63 is constituted so that the near infrared ray light of the range whose wavelength is 0.7-2.5 micrometers may be detected. The reflecting mirror 61, the concave grating 62, and the array mold photo detector 63 are arranged in the black box 65 made from the aluminum which shades the light from the outside, and the transmitted light drawn with the optical fiber 51 for light-receiving is constituted so that it may lead in a black box 65 through the incidence hole 66 formed in the black box 65. P in drawing shows the optical path from the light source 1 to the array mold photo detector 63.
[0017] The supporter material 75 of the rail 74 to which it shows the electric motor 71 for spacing modification of a pair, the pinion 72 of the pair connected with the revolving shaft of the electric motor 71 for spacing modification, respectively, the rack 73 of the pair arranged so that it may gear with a pinion 72, respectively, and the rack 73 of a pair, and the pair which fixed to rack 73 each constitutes the spacing modification means 7. One supporter material 75 fixes to the fiber attaching

part 31 of the exposure section 3, and the supporter material 75 of another side is fixed to the fiber attaching part 41 of a light sensing portion 4. that is, electric motor 71 each for spacing modification of a pair -- forward rotation or carrying out inverse rotation -- the rack 73 of a pair -- mutual -- approach or alienation -- make it move, follow on it and the exposure section 3 and the light sensing portion 4 of each other are made to approach or estrange, and it constitutes so that spacing of the exposure section 3 and a light sensing portion 4 may be adjusted.
[0018] Based on the detecting signal from rotary encoder [of the pair prepared in the electric motor 71 for spacing modification, respectively] 81, and rotary encoder of pair 81 each, a spacing operation means 82 to calculate spacing (namely, the optical path length L) of the exposure section 3 and a light sensing portion constitutes the interval measurement means 8.
[0019] The electric motor 92 for installation base rotation made to rotate the installation base 91 in which Sample S is laid, and the installation base 91 to the circumference of the axis-of-ordinate heart Q constitutes the sample supporter 9. In addition, although not illustrated, the installation base 91 is formed free [vertical migration], and it is constituted according to the magnitude and the configuration of Sample S so that the height adjustment of the installation base 91 may be possible. That is, by rotating the installation base 91 with the electric motor 92 for installation base rotation, in Sample S, the sample supporter 9 is constituted so that it may be rotatable.
[0020] The signal-processing means 64 of the spectral-analysis means 6 is constituted using the microcomputer. C in drawing is a control unit which manages various control of spectral-analysis equipment, and is constituted using the microcomputer. The spacing operation means 82 of the interval measurement means 8 is constituted using the control unit C. Moreover, E in drawing is an input unit which inputs various analysis conditions, and it is constituted so that the various analysis conditions of having been inputted may be transmitted to a control unit C and signal-processing means 64 each. The input device E consists of keyboards. Moreover, D in drawing is an output unit which outputs the processing result of the signal-processing means 64, and consists of CRT display devices.
[0021] Next, explanation is added about the signal-processing means 64. Fundamentally, the signal-processing means 64 computes the amount of components contained in Sample S based on the quadratic differential value while it processes the output signal from the array mold photo detector 63 and acquires the quadratic differential value in the wavelength field of an absorbance spectrum and an absorbance spectrum. An absorbance is Log (I/T) when the quantity of light of I and the transmitted light is set to T for the exposure quantity of light (criteria quantity of light) of the light source.
It comes out and defines. By the way, the following relation between an absorbance and the optical path length L is.
Log(I/T) =epsiloncL, however the multiplier c defined with the form of the epsilon; sample S; it is proportional to the optical path length L, the consistency, i.e., the absorbance, of Sample S.
[0022] In a fixed case, the optical path length L can compute the amount of components contained in Sample S based on the multiple regression analysis by the following formula (the amount formula of components is called hereafter).
Y=K0+K1 xA(lambda 1)+K2 xA(lambda 2)+K3 xA (lambda 3) .... however Y coefficient A (lambda 1), and A (lambda 2) and A (lambda 3) .. quadratic differential value of the absorbance spectrum in; specification wavelength lambda ; The amount K0 of components, K1, K2, and K3 .. ; [0023] In this invention, since the optical path length L is changed according to the magnitude of Sample S, the signal-processing means 64 is constituted by amending the quadratic differential value in the wavelength field of an absorbance spectrum based on the optical path length L who measured with the interval measurement means 8 so that the amount of components (it is hereafter written as the amount of components after optical-path-length amendment) amended based on the optical path length L may be computed. That is, based on the following optical-path-length correction formula, amount [after optical-path-length amendment] of components Y (L) is computed.
Y(L) =(L0 / L) x{alpha0 x K0+alpha1 xK1 xA(lambda 1)+alpha2 xK2 xA(lambda 2)+alpha3 xK3 xA

(lambda 3) ....}
However, L0 ; The criteria optical path length alpha 0, alpha 1, alpha 2, alpha3 ....; optical-path-length correction factor [0024] The specific optical-path-length correction formula is set to the signal-processing means 64 for every component about each form of the garden stuff used as Sample S. That is, in the above-mentioned optical-path-length correction formula, the specific multiplier K0, K1, K2, K3 ...., wavelength lambda 1, lambda 2, lambda3 .. and the optical-path-length correction factor alpha 0, alpha 1, alpha 2, and alpha3 .. are set up for every component about each form of garden stuff. And the signal-processing means 64 computes amount [after optical-path-length amendment] of components Y (L) using the optical-path-length correction formula set up for every component according to the form of garden stuff inputted with the input means E. That is, the spectral-analysis means 6 is constituted so that the component for which it asks based on the optical path length L who measured with the interval measurement means 8 may be amended.
[0025] Next, the case where the quantum of the amount of components of each component contained in the tomato as an example of Sample S is carried out is explained. In a tomato, as a component relevant to a degree of sweetness, there are a glucose and a fructose, as a component in relation to whenever [acid taste], there is a citric acid and there is an ascorbic acid as vitamin C as a component in relation to whenever [nutrition]. The specific wavelength lambda in the above-mentioned optical-path-length correction formula at the time of computing the amount of components of a glucose is set as 750, 830, 915, 1030, 1080, 1205, and 1260 or 1380nm. The specific wavelength lambda in the above-mentioned optical-path-length correction formula at the time of computing the amount of components of a fructose is set as 750, 830, 915, 1030, 1080, 1205, and 1260 or 1380nm. The specific wavelength lambda in the above-mentioned optical-path-length correction formula at the time of computing the amount of components of a citric acid is set as 775, 900, 1005, 1060, 1170, and 1240 or 1375nm. The specific wavelength lambda in the above-mentioned optical-path-length correction formula at the time of computing the amount of components of an ascorbic acid is set as 760, 920, 995, 1200, and 1265 or 1355nm.
[0026] Next, control actuation of a control unit C is explained based on the flow chart shown in drawing 3 . If the form of garden stuff and the analysis conditions of the set point N of the count of a quantum of the amount of components are inputted by the input unit E, the counter which counts the count n of a quantum will be reset, and angle of rotation of the installation base 91 will be computed based on the set point N of the inputted count of a quantum (step #1-# 3). Angle of rotation of the installation base 91 is computed by **(ing) 360 degrees by the count N of a quantum. It operates so that the exposure section 3 may be moved in the direction approaching Sample S until ON signal is outputted from a limit switch 33 in the electric motor 71 for spacing modification by the side of the exposure section 3. While operating so that a light sensing portion 4 may be moved in the direction approaching Sample S until ON signal is outputted to a list from a limit switch 43 in the electric motor 71 for spacing modification by the side of a light sensing portion 4 When the detecting signal of rotary encoder 81 each of a pair is read and ON signal is outputted from both limit switches 33 and 43 in parallel to actuation of the electric motor 71 for spacing modification of these pairs, the optical path length L is calculated with the spacing operation means 82 (step #4-# 8).
[0027] Then, amount [of each component after optical-path-length amendment] of components Y (L) is computed with the signal-processing means 64 using the optical-path-length correction formula set up for every component (step # 9). Then, 1 is added to the count n of a quantum (step # 10). Then, it judges whether the count n of a quantum is equal to the set point N (step # 11), and when not equal, electric motor 71 each for spacing modification is operated so that only the set point may be moved in the direction which estranges the exposure section 3 and the light sensing portion 4 of each other, in order to make the exposure section 3 and a light sensing portion 4 estrange from Sample S (step # 12). Then, the electric motor 92 for installation base rotation is operated (step # 13), and it returns to step #4 so that only angle of rotation which computed the installation base 91 in step #3 may be rotated. In

each location where N parts differ as mentioned above, each amount of components of Sample S is computed.

[0028] Then, in step #11, when the count n of a quantum judges that it is equal to the set point N, for every component, the amount of calculation components of N individual is averaged, the average is outputted to an output unit D (step #14-# 15), and one analysis is ended. that is, two or more different locations [in / based on rotation of the sample S according / the spectral-analysis means 6 / to the sample supporter 9 / Sample S] -- setting -- a spectrum -- the spectrum which obtained the spectrum and was obtained -- it constitutes so that the quantum of the amount of components contained in Sample S based on a spectrum may be carried out.

[0029] [Other Example(s)]

Next, another example is explained.

** the above-mentioned example -- the electric motor 71 for spacing modification of a pair -- the rack 73 of a pair -- mutual -- approach and alienation -- it was made to move and followed on it, and it illustrated about the case where the spacing modification means 7 is constituted so that the exposure section 3 and the light sensing portion 4 of each other might be made to approach and estrange. this -- replacing with -- one electric motor for spacing modification -- the rack 73 of a pair -- mutual -- approach and alienation -- it may be made to move and may follow on it, and you may constitute so that the exposure section 3 and the light sensing portion 4 of each other may be made to approach and estrange. In this case, the configuration of the spacing modification means 7 becomes easy.

[0030] ** in order to change spacing of the exposure section 3 and a light sensing portion 4 in the above-mentioned example -- both the exposure section 3 and the light sensing portion 4 -- a straight-line round trip -- although it illustrated about the case where the spacing modification means 7 is constituted so that it might be movable -- this -- replacing with -- either the exposure section 3 or the light sensing portions 4 -- fixing -- preparing -- another side -- a straight-line round trip -- you may constitute movable. In this case, the configuration of the spacing modification means 7 becomes still easier.

[0031] ** although it illustrated about the case where the sample supporter 9 is constituted, in the above-mentioned example so that it might be rotatable in Sample S -- this -- replacing with -- Sample S -- linear -- a round trip -- you may constitute so that it may be movable. In this case, it is effective especially when Sample S is a long picture. Moreover, you may constitute so that Sample S may not be rotated.

[0032] ** In the above-mentioned example, by amending the quadratic differential value in the wavelength field of an absorbance spectrum based on the optical path length L who measured with the interval measurement means 8, it illustrated about the case where the signal-processing means 64 is constituted so that amount [after optical-path-length amendment] of components Y (L) might be computed. It may replace with this, the amount Y of components may be first computed in the above-mentioned amount formula of components, and the amount Y of calculation components may be amended based on the optical path length L by the following formula, and you may constitute so that amount [after optical-path-length amendment] of components Y (L) may be computed.

Y(L) =(L0 / L) x alphaxY, however alpha; the optical-path-length correction factor set up for every component [0033] ** Various configurations are applicable although illustrated about the case where a limit switch is applied, as a concrete configuration of the contact detection means 33 and 43 in the above-mentioned example. For example, a light emitting device and a photo detector may be constituted by arranging so that the light from a light emitting device may be interrupted by Sample S and may not reach a photo detector, if Sample S contacts the exposure section 3 or a light sensing portion 4.

[0034] ** The various garden stuff other than the tomato shown in the above-mentioned example as a sample S, such as a cabbage, a cucumber, a green pepper, broccoli, and a strawberry, is applicable. Moreover, the thing of arbitration, such as food and resin, can be applied in addition to garden stuff,

and it is **. Moreover, the quantum of the amount of components of various components, such as moisture, protein, a lipid, and minerals, can be carried out in addition to the component shown in the above-mentioned example.
[0035] ** The specific wavelength lambda in the above-mentioned optical-path-length correction formula at the time of computing the amount of components of a glucose, a fructose, a citric acid, and each ascorbic acid can choose some from from suitably among two or more specific wavelength lambda illustrated for every component in the above-mentioned example. Moreover, it illustrated in the above-mentioned example, and also the specific wavelength lambda in each component can be changed suitably.
[0036] ** Based on each amount of components which carried out the quantum, the quality of Sample S may be distinguished, and although illustrated about the case where the quantum of the amount of components of each component is carried out, you may constitute from an above-mentioned example so that the distinction result may be outputted to an output unit D. Moreover, based on each amount of components which carried out the quantum in the location where the plurality in Sample S differs, a specific component may pinpoint many [unusually] parts, or may search for the variation in the amount of components of a specific component, and may output those results to an output unit D. For example, a corrosion part can be pinpointed when a corrosion component pinpoints many [unusually] parts. Moreover, the distribution condition of a sweet part or a sour part can be known by searching for the variation in the amount of components of the component in relation to whenever [degree-of-sweetness or acid taste]. Moreover, since the optical path length L who measured with the interval measurement means 8 is equivalent to the magnitude of Sample S, he outputs the optical path length L who measured to an output unit D as magnitude of Sample S, and may enable it for magnitude to classify Sample S based on the output.
[0037] ** A spectral-analysis means is not limited to the thing of a configuration of that the above-mentioned example was shown.
[0038] In addition, although a sign is described in order to make contrast with a drawing convenient at the term of a claim, this invention is not limited to the configuration of an accompanying drawing by this entry.

[Translation done.]

TECHNICAL FIELD

[Industrial Application] the spectrum of the transmitted light which the exposure section to which this invention irradiates the bundle of rays for measurement from the light source at a sample, the light sensing portion which receives the transmitted light which penetrated said sample, and its light sensing portion received -- the spectrum which obtained the spectrum and was obtained -- it is related with the spectral-analysis equipment with which a spectral-analysis means to ask for the component contained in said sample based on a spectrum was established.

[Translation done.]

PRIOR ART

[Description of the Prior Art] This spectral-analysis equipment detects the class of component contained in the sample for [, such as garden stuff,] analysis, or carries out the quantum of the amount of components, and asks for the component contained in a sample. In this spectral-analysis equipment, the exposure section and a light sensing portion had fixed and prepared those spacing in the predetermined value in the condition of having fixed, conventionally.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] According to the 1st description configuration, even if the magnitude and the configuration of a sample differed from each other, it could ask for the component simply contained in a sample.
[0012] two or more spectra which were obtained in each location where plurality differs according to the 2nd description configuration -- since it asked for the component contained in a sample based on a spectrum, it could ask for the component with a much more sufficient precision. It is effective when asking for the component of the sample from which a consistency differs with a location like a cabbage or a green pepper especially.
[0013] according to the 3rd description configuration -- the exposure section and a light sensing portion small [a spacing modification means] and lightweight -- approach and alienation -- since what is necessary is just to constitute so that it may be made to move, it can consider as an easy configuration and the cost for carrying out this invention can be reduced. Moreover, since the effect of the heat from the light source to a sample can be prevented, it is suitable when asking heat for the component of a weak sample like garden stuff especially.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, when there is a thing of various magnitude in the sample for analysis and the forms of a sample differ, the configuration and magnitude of a sample differ from each other. Therefore, in the former, the sample needed to be fabricated by cutting etc. according to spacing of the exposure section and a light sensing portion, and it was very troublesome at it.
[0004] This invention is made in view of this actual condition, and the purpose is in offering the spectral-analysis equipment which can ask for the component simply contained in a sample, even if the magnitude and the configuration of a sample differ from each other.

[Translation done.]

MEANS

[Means for Solving the Problem] A spacing modification means by which the 1st description configuration of the spectral-analysis equipment by this invention changes spacing of said exposure section and said light sensing portion, and an interval measurement means to measure spacing of said exposure section and said light sensing portion are established, and said spectral-analysis means is in the point constituted so that the component for which it asks based on spacing which said interval measurement means measured may be amended.
[0006] two or more different locations [in / based on rotation of said sample according / the sample supporter with which the 2nd description configuration supports said sample is constituted so that it may be rotatable in said sample, and / said spectral-analysis means / to said sample supporter / said sample] -- setting -- a spectrum -- two or more spectra which obtained a spectrum and were obtained -- it is in the point constituted so that it may ask for the component contained in said sample based on a spectrum.
[0007] The 3rd description configuration is connected with the optical fiber for an exposure with which said light source and said exposure section lead the pencil of light rays for measurement from said light source to said exposure section, and said light sensing portion and said spectral-analysis means are in the point connected with the optical fiber for light-receiving which leads the transmitted light which said light sensing portion received to said spectral-analysis means.

[Translation done.]

OPERATION

[Function] The operation by the 1st description configuration is as follows. According to the magnitude and the configuration of a sample, spacing of the exposure section and a light sensing portion is changed with a spacing modification means. Although the distance (the optical path length is called hereafter) in which the bundle of rays for measurement from the exposure section passes a sample differs and the absorbances of the bundle of rays for measurement irradiated by the sample differ since the magnitude of a sample differs, it turns out that the absorbance of the bundle of rays for measurement is proportional to the optical path length. Then, spacing (namely, optical path length) of the exposure section and a light sensing portion is measured with an interval measurement means, and a spectral-analysis means amends the component for which it asks based on the time between measurements.
[0009] The operation by the 2nd description configuration is as follows. the location where a sample rotates with a sample supporter and the plurality in a sample changes with spectral-analysis means based on the rotation -- setting -- a spectrum -- a spectrum -- obtaining -- the spectrum of these plurality -- it asks for the component contained in a sample based on a spectrum.
[0010] The operation by the 3rd description configuration is as follows. Although the light source and a spectral-analysis means are large-sized and weight is heavy, since, as for each optical fiber, it has flexibility when changing spacing of the exposure section and a light sensing portion, the light source and a spectral-analysis means are in the fixed condition, and can change spacing of the exposure section and a light sensing portion by making the exposure section and a light sensing portion approach mutually, or making it move so that it may be made to estrange. therefore, the exposure section and a light sensing portion small [a spacing modification means] and lightweight -- approach and alienation -- it can constitute so that it may be made to move. Moreover, since a sample can be arranged in the location distant from the light source, it can prevent the effect of the heat from the light source to a sample.

[Translation done.]

EXAMPLE

[Example] The example applied to the spectral-analysis equipment which analyzes hereafter the component contained in garden stuff in this invention is explained based on a drawing. The first optical system 2 by which spectral-analysis equipment fabricates the bundle of rays for measurement from the light source 1 and its light source 1 as shown in drawing 1 , The exposure section 3 which irradiates the bundle of rays for measurement from the 1st optical system 2 at Sample S, and the light sensing portion 4 which receives the transmitted light which penetrated Sample S, the spectrum of the transmitted light led according to the second optical system 5 which draws the transmitted light which the light sensing portion 4 received, and the second optical system 5 -- the spectrum which obtained the spectrum and was obtained -- with a spectral-analysis means 6 to ask for the component contained in Sample S based on a spectrum A spacing modification means 7 to change spacing (namely, the optical path length L) of the exposure section 3 and a light sensing portion 4, an interval measurement means 8 to measure spacing of the exposure section 3 and a light sensing portion 4, and the sample supporter 9 that supports Sample S in the rotatable condition are constituted as main components.
[0015] The light source 1 consists of tungsten halogen lamps which emit infrared light. The lens 21 which fabricates the light source bundle for measurement from the light source 1 to a parallel pencil of rays, and the optical fiber 22 for an exposure which leads a parallel pencil of rays to the exposure section 3 constitute the first optical system 2. The optical fiber 51 for light-receiving which leads the transmitted light which the light sensing portion 4 received to the spectral-analysis means 6 constitutes the second optical system 5. That is, the light source 1 and the exposure section 3 are connected with the optical fiber 22 for an exposure which leads the pencil of light rays for measurement from the light source 1 to the exposure section 3, and the light sensing portion 4 and the spectral-analysis means 6 are connected with the optical fiber 51 for light-receiving which leads the transmitted light which the light sensing portion 4 received to the spectral-analysis means 6. As shown also in drawing 2 , a contact detection means 33 to detect the fiber attaching part 31 which inner-****** the optical fiber 22 for an exposure, the pad 32 made of rubber of the bowl configuration which sticks to Sample S and shades the light from the outside, and that the exposure section 3 contacted Sample S constitutes the exposure section 3. Similarly, the fiber attaching part 41 to which a light sensing portion 4 also inner-****** the optical fiber 51 for light-receiving, the pad 42 made of rubber of a bowl configuration which sticks to Sample S and shades the light from the outside, and a contact detection means 43 to detect that the light sensing portion 4 contacted Sample S constitute. The limit switch which outputs ON signal constitutes the contact detection means 33 and 43 by contacting Sample S.
[0016] The spectral-analysis means 6 is equipped with a signal-processing means 64 to process the output signal from the reflecting mirror 61 which reflects the transmitted light drawn with the optical fiber 51 for light-receiving, the concave grating 62 which carries out the part light reflex of the transmitted light reflected by the reflecting mirror 61, the array mold photo detector 63 which detects

the bundle-of-rays reinforcement for every wavelength in which the part light reflex was carried out by the concave grating 62, and the array mold photo detector 63. The array mold photo detector 63 changes and outputs the transmitted light by which the part light reflex was carried out by the concave grating 62 to the signal for every wavelength while receiving light for every wavelength to coincidence. Moreover, the array mold photo detector 63 is constituted so that the near infrared ray light of the range whose wavelength is 0.7-2.5 micrometers may be detected. The reflecting mirror 61, the concave grating 62, and the array mold photo detector 63 are arranged in the black box 65 made from the aluminum which shades the light from the outside, and the transmitted light drawn with the optical fiber 51 for light-receiving is constituted so that it may lead in a black box 65 through the incidence hole 66 formed in the black box 65. P in drawing shows the optical path from the light source 1 to the array mold photo detector 63.
[0017] The supporter material 75 of the rail 74 to which it shows the electric motor 71 for spacing modification of a pair, the pinion 72 of the pair connected with the revolving shaft of the electric motor 71 for spacing modification, respectively, the rack 73 of the pair arranged so that it may gear with a pinion 72, respectively, and the rack 73 of a pair, and the pair which fixed to rack 73 each constitutes the spacing modification means 7. One supporter material 75 fixes to the fiber attaching part 31 of the exposure section 3, and the supporter material 75 of another side is fixed to the fiber attaching part 41 of a light sensing portion 4. that is, electric motor 71 each for spacing modification of a pair -- forward rotation or carrying out inverse rotation -- the rack 73 of a pair -- mutual -- approach or alienation -- make it move, follow on it and the exposure section 3 and the light sensing portion 4 of each other are made to approach or estrange, and it constitutes so that spacing of the exposure section 3 and a light sensing portion 4 may be adjusted.
[0018] Based on the detecting signal from rotary encoder [of the pair prepared in the electric motor 71 for spacing modification, respectively] 81, and rotary encoder of pair 81 each, a spacing operation means 82 to calculate spacing (namely, the optical path length L) of the exposure section 3 and a light sensing portion constitutes the interval measurement means 8.
[0019] The electric motor 92 for installation base rotation made to rotate the installation base 91 in which Sample S is laid, and the installation base 91 to the circumference of the axis-of-ordinate heart Q constitutes the sample supporter 9. In addition, although not illustrated, the installation base 91 is formed free [vertical migration], and it is constituted according to the magnitude and the configuration of Sample S so that the height adjustment of the installation base 91 may be possible. That is, by rotating the installation base 91 with the electric motor 92 for installation base rotation, in Sample S, the sample supporter 9 is constituted so that it may be rotatable.
[0020] The signal-processing means 64 of the spectral-analysis means 6 is constituted using the microcomputer. C in drawing is a control unit which manages various control of spectral-analysis equipment, and is constituted using the microcomputer. The spacing operation means 82 of the interval measurement means 8 is constituted using the control unit C. Moreover, E in drawing is an input unit which inputs various analysis conditions, and it is constituted so that the various analysis conditions of having been inputted may be transmitted to a control unit C and signal-processing means 64 each. The input device E consists of keyboards. Moreover, D in drawing is an output unit which outputs the processing result of the signal-processing means 64, and consists of CRT display devices.
[0021] Next, explanation is added about the signal-processing means 64. Fundamentally, the signal-processing means 64 computes the amount of components contained in Sample S based on the quadratic differential value while it processes the output signal from the array mold photo detector 63 and acquires the quadratic differential value in the wavelength field of an absorbance spectrum and an absorbance spectrum. An absorbance is Log (I/T) when the quantity of light of I and the transmitted light is set to T for the exposure quantity of light (criteria quantity of light) of the light source.
It comes out and defines. By the way, the following relation between an absorbance and the optical path length L is.

Log(I/T) =epsiloncL, however the multiplier c defined with the form of the epsilon; sample S; it is proportional to the optical path length L, the consistency, i.e., the absorbance, of Sample S.
[0022] In a fixed case, the optical path length L can compute the amount of components contained in Sample S based on the multiple regression analysis by the following formula (the amount formula of components is called hereafter).
Y=K0+K1 xA(lambda 1)+K2 xA(lambda 2)+K3 xA (lambda 3) .... however Y coefficient A (lambda 1), and A (lambda 2) and A (lambda 3) .. quadratic differential value of the absorbance spectrum in; specification wavelength lambda ; The amount K0 of components, K1, K2, and K3 .. ; [0023] In this invention, since the optical path length L is changed according to the magnitude of Sample S, the signal-processing means 64 is constituted by amending the quadratic differential value in the wavelength field of an absorbance spectrum based on the optical path length L who measured with the interval measurement means 8 so that the amount of components (it is hereafter written as the amount of components after optical-path-length amendment) amended based on the optical path length L may be computed. That is, based on the following optical-path-length correction formula, amount [after optical-path-length amendment] of components Y (L) is computed.
Y(L) =(L0 / L) x{alpha0 x K0+alpha1 xK1 xA(lambda 1)+alpha2 xK2 xA(lambda 2)+alpha3 xK3 xA (lambda 3) ....}
However, L0 ; The criteria optical path length alpha 0, alpha 1, alpha 2, alpha3 ....; optical-path-length correction factor [0024] The specific optical-path-length correction formula is set to the signal-processing means 64 for every component about each form of the garden stuff used as Sample S. That is, in the above-mentioned optical-path-length correction formula, the specific multiplier K0, K1, K2, K3 ...., wavelength lambda 1, lambda 2, lambda3 .. and the optical-path-length correction factor alpha 0, alpha 1, alpha 2, and alpha3 .. are set up for every component about each form of garden stuff. And the signal-processing means 64 computes amount [after optical-path-length amendment] of components Y (L) using the optical-path-length correction formula set up for every component according to the form of garden stuff inputted with the input means E. That is, the spectral-analysis means 6 is constituted so that the component for which it asks based on the optical path length L who measured with the interval measurement means 8 may be amended.
[0025] Next, the case where the quantum of the amount of components of each component contained in the tomato as an example of Sample S is carried out is explained. In a tomato, as a component relevant to a degree of sweetness, there are a glucose and a fructose, as a component in relation to whenever [acid taste], there is a citric acid and there is an ascorbic acid as vitamin C as a component in relation to whenever [nutrition]. The specific wavelength lambda in the above-mentioned optical-path-length correction formula at the time of computing the amount of components of a glucose is set as 750, 830, 915, 1030, 1080, 1205, and 1260 or 1380nm. The specific wavelength lambda in the above-mentioned optical-path-length correction formula at the time of computing the amount of components of a fructose is set as 750, 830, 915, 1030, 1080, 1205, and 1260 or 1380nm. The specific wavelength lambda in the above-mentioned optical-path-length correction formula at the time of computing the amount of components of a citric acid is set as 775, 900, 1005, 1060, 1170, and 1240 or 1375nm. The specific wavelength lambda in the above-mentioned optical-path-length correction formula at the time of computing the amount of components of an ascorbic acid is set as 760, 920, 995, 1200, and 1265 or 1355nm.
[0026] Next, control actuation of a control unit C is explained based on the flow chart shown in drawing 3 . If the form of garden stuff and the analysis conditions of the set point N of the count of a quantum of the amount of components are inputted by the input unit E, the counter which counts the count n of a quantum will be reset, and angle of rotation of the installation base 91 will be computed based on the set point N of the inputted count of a quantum (step #1-# 3). Angle of rotation of the installation base 91 is computed by **(ing) 360 degrees by the count N of a quantum. It operates so that the exposure section 3 may be moved in the direction approaching Sample S until ON signal is

outputted from a limit switch 33 in the electric motor 71 for spacing modification by the side of the exposure section 3. While operating so that a light sensing portion 4 may be moved in the direction approaching Sample S until ON signal is outputted to a list from a limit switch 43 in the electric motor 71 for spacing modification by the side of a light sensing portion 4 When the detecting signal of rotary encoder 81 each of a pair is read and ON signal is outputted from both limit switches 33 and 43 in parallel to actuation of the electric motor 71 for spacing modification of these pairs, the optical path length L is calculated with the spacing operation means 82 (step #4-# 8).

[0027] Then, amount [of each component after optical-path-length amendment] of components Y (L) is computed with the signal-processing means 64 using the optical-path-length correction formula set up for every component (step # 9). Then, 1 is added to the count n of a quantum (step # 10). Then, it judges whether the count n of a quantum is equal to the set point N (step # 11), and when not equal, electric motor 71 each for spacing modification is operated so that only the set point may be moved in the direction which estranges the exposure section 3 and the light sensing portion 4 of each other, in order to make the exposure section 3 and a light sensing portion 4 estrange from Sample S (step # 12). Then, the electric motor 92 for installation base rotation is operated (step # 13), and it returns to step #4 so that only angle of rotation which computed the installation base 91 in step #3 may be rotated. In each location where N parts differ as mentioned above, each amount of components of Sample S is computed.

[0028] Then, in step #11, when the count n of a quantum judges that it is equal to the set point N, for every component, the amount of calculation components of N individual is averaged, the average is outputted to an output unit D (step #14-# 15), and one analysis is ended. that is, two or more different locations [in / based on rotation of the sample S according / the spectral-analysis means 6 / to the sample supporter 9 / Sample S] -- setting -- a spectrum -- the spectrum which obtained the spectrum and was obtained -- it constitutes so that the quantum of the amount of components contained in Sample S based on a spectrum may be carried out.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram of the spectral-analysis equipment concerning the example of this invention
[Drawing 2] Drawing of longitudinal section of the exposure section of spectral-analysis equipment
[Drawing 3] Drawing showing the flow chart of control actuation
[Description of Notations]
1 Light Source
3 Exposure Section
4 Light Sensing Portion
6 Spectral-Analysis Means
7 Spacing Modification Means
8 Interval Measurement Means
9 Sample Supporter
22 Optical Fiber for Exposure
51 Optical Fiber for Light-receiving

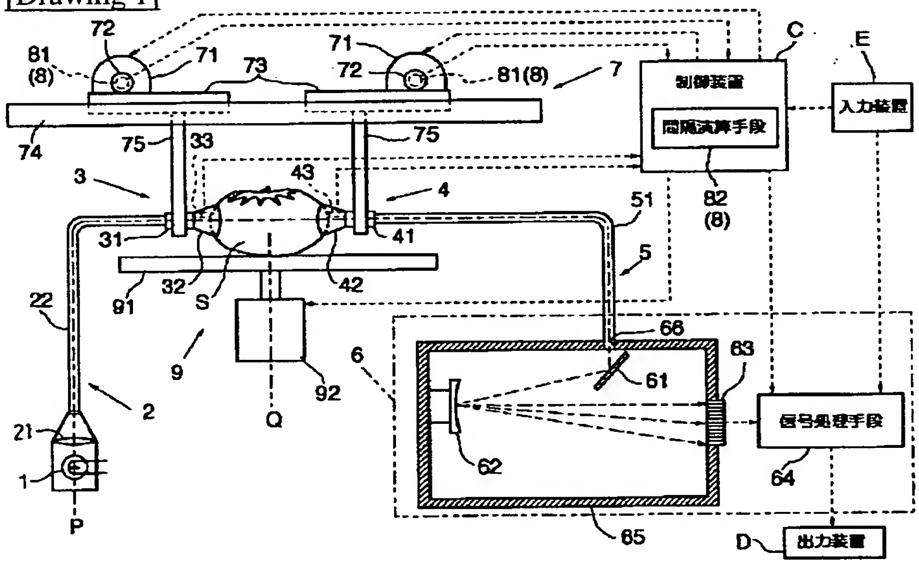
[Translation done.]

* NOTICES *

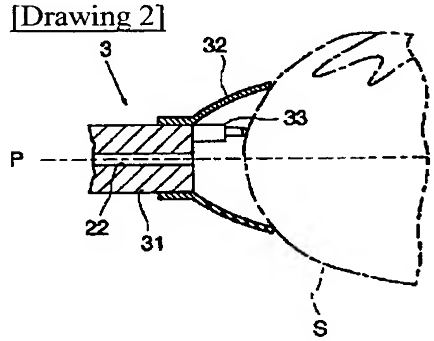
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

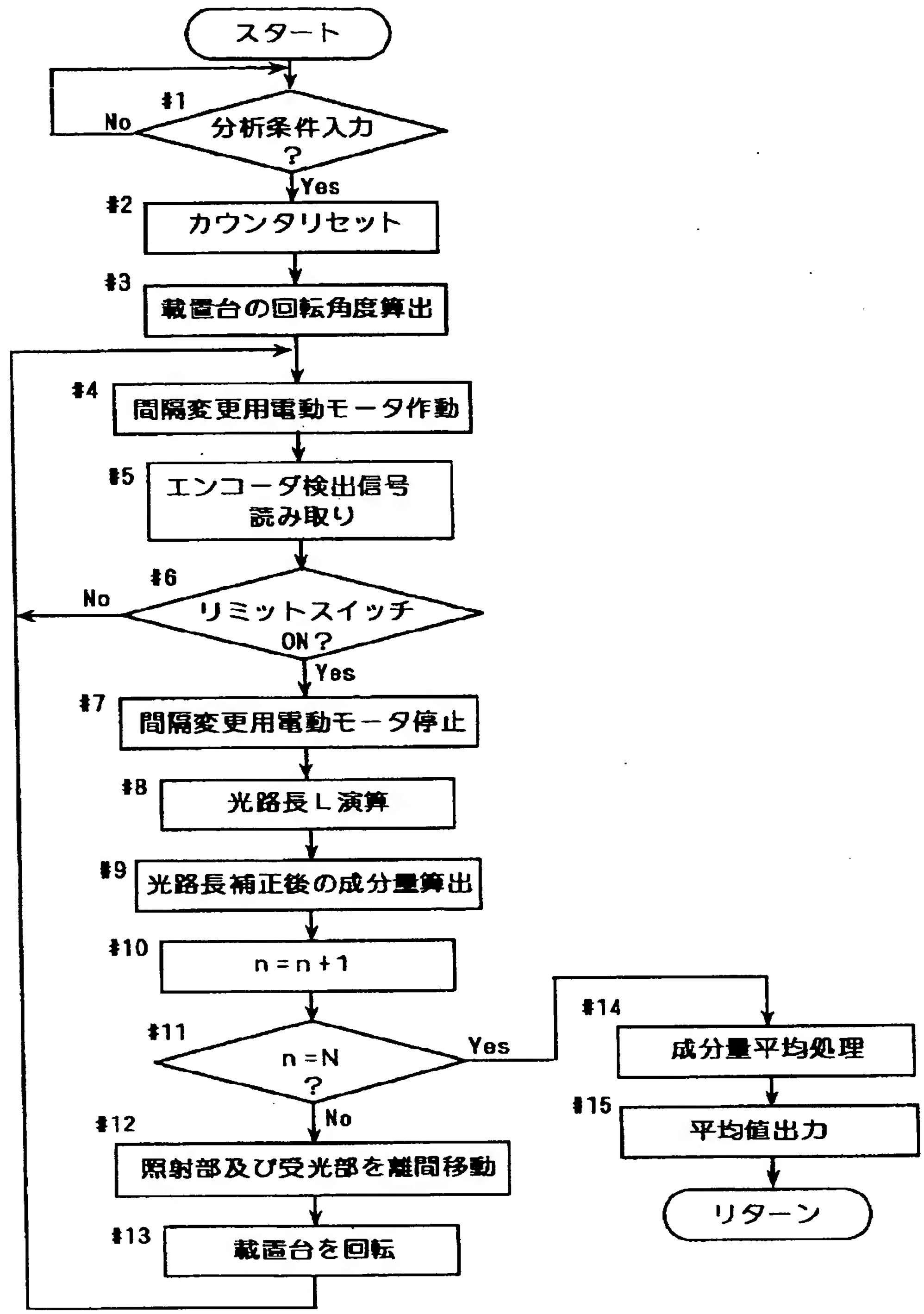
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]

SPECTRUM ANALYSER

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Publication date: 1996-02-02
Inventor: TAKIZAWA SEIICHI; SAKAI CHIAKI; IGARASHI KEISUKE; YAMAUCHI RYOGO
Applicant: KUBOTA KK
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- international: *G01N21/27; G01N21/59;* **G01N21/25; G01N21/59;** (IPC1-7): G01N21/27; G01N21/59
- european:
Application number: JP19940163477 19940715
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Abstract of **JP8029333**

PURPOSE:To provide a spectrum analyser capable of simply obtaining a component contained in a sample even when the size or shape of the sample is different.
CONSTITUTION:The spectrum analyser is equipped with an irradiation part 3 irradiating a sample with the measuring luminous flux from a light source 1, a light detection part 4 detecting the light passing through the sample and a spectrum analyzing means 6 obtaining the spectrum of the transmitted light detected by the light detection part 4 to obtain the component contained in the sample on the basis of the obtained spectrum. Further, an interval altering means 7 altering the interval between the irradiation part 3 and the light detection part 4 and an interval measuring means 8 measuring the interval between the irradiation part 3 and the light detection part 4 are provided and the spectrum analyzing means 6 corrects the component calculated on the basis of the interval measured by the interval measuring means 8.